REMARKS

Present Status of the Application

This is a full and timely response to the outstanding non-final Office Action mailed on January 15, 2004. The Office Action has rejected to claims 1, 4-6, 9-10, 12, 14, 16-17, 19, 21-22 under 35 U.S.C. 102(a) as being anticipated by Yoda (US 20020061641). The Office Action has further rejected to claims 1-22 under 35 U.S.C. 103(a) as being unpatentable over Yoda (US 20020061641) or Yoda in view of Amagi (US 6,762,506) or in view of Takano (US 20020173108).

Claims 1-22 remain pending of which claims 1, 5, 10 and 17 have been amended to more accurately describe the invention and to correct editorial errors. It is believed that no new matter is added by way of these amendments made to the claims or otherwise to the application.

Applicant has most respectfully considered the remarks set forth in this Office Action. Regarding the anticipated rejection, it is however strongly believed that the cited references are deficient to adequately teach the claimed features as recited in the amended claims. The reasons that motivate the above position of the Applicant are discussed in detail hereafter, upon which reconsideration of the claims is most earnestly solicited.

Discussion of Office Action Rejections

The Office Action rejected claims 1, 4-6, 9-10, 12, 14, 16-17, 19, 21-22 under 35 U.S.C. § 102(a), as being anticipated by Yoda (US 20020061641).

To properly anticipate Applicants' claimed invention under 35 U.S.C. § 102 "requires the disclosure in a single prior art reference of each element of the claim under consideration." W.L. Gore & Associates, Inc. v. Garlock, Inc., 721 F.2d 1540, 220 U.S.P.Q. 303, 313 (Fed. Cir. 1983).

The present invention is in general related to a bump structure or a method of fabricating a bump structure that includes a gold bump and a reaction barrier layer disposed directly on the gold bump, wherein the reaction barrier layer is constituted with a nickel layer or a nickel layer and a copper layer on the nickel layer. With the formation of a nickel layer or Cu/Ni bi-layer on the gold bump, which mitigates the reaction between the gold bump and the lead-free soldering materials (copper-containing solder), the formation of cold joint between the gold bump and the copper-containing solders is prevented.

Yoda teaches in paragraph [0096] a metal layer that is formed with a first metal layer 40 and a second metal layer 42, wherein these metal layers 40, 42 may be formed with a variety of metals such as nickel, gold, copper, palladium and tin, or tin with at least one selected from Ag, Cu, Bi, and Zn. Applicant respectfully disagree with the Office's a ssertion that the scope of the disclosure encompasses the particular claimed order because the prior art specifies

that of multiple layers, the lowest layer is formed of nickel and the outermost layer is of gold or tin (see paragraph [0096]). Yoda also teaches in paragraph [108] that the second metal layer 42 comprising a single layer or multiple layers and at least the surface thereof formed of gold or copper is formed on the first metal layer 40 which is a nickel layer. In the present invention, the surface layer of the bump structure can not be a gold layer. Instead, the surface layer of the bump structure of the instant case is a nickel layer or a copper/nickel bi-layer. Moreover, the prior art reference is directed to the formation of a bump 50 that bonds with a gold solder material (see paragraph 115), whereas the present invention is directed to the formation of a gold bump structure that bonds with a copper-containing solders.

In summary, the present invention teaches forming a nickel or a nickel-copper bilayer on the gold bump such that the reaction between the gold bump and the copper-containing solder is retarded due to a self-formed compound at the solder/gold interface. Since the prior art fails to teach or suggest forming a nickel layer on the gold bump or forming a nickel/copper bilayer on the gold bump layer to react with a copper-containing solder material, Applicants respectfully assert that Yoda fails to render claims 1 5, 10 and 17 anticipated. Since claims *4, 6, 9, 12, 14, 16, 19, 21-22* are dependent claims which further define the invention recited in claims 1 5, 10 and 17, respectively, Applicants respectfully assert that claims *4, 6, 9, 12, 14, 16, 19, 21-22* are also in condition for allowance. Thus, reconsideration and withdrawal of these rejections are respectively requested.

The Office Action rejected claims 2, 3, 7 and 8 under 35 U.S.C. § 103(a), as being unpatentable over Yoda (US 20020061641).

The Office Action rejected claims 1-10, 12, 14, 16-17, 19, 21-22 under 35 U.S.C. § 103(a), as being unpatentable over Yoda (US 20020061641).

With regard to the obvious rejections of claims *by Yoda,* Applicants respectfully submit that these claims patently define over the prior art for at least the same reasons discussed above.

Although the Office concedes that Yoda fails to teach the specific concentrations (thicknesses) or the specific order for the various metal layers, the Office asserts it is a matter of design choice. Applicants respectfully disagree. In fact, the nickel layer/copper layer with the appropriate thickness formed on the gold bump, the Cu-Ni-Sn self-formed compound formed at the interface of the gold bump structure and the solder will prevent the rapid interaction of the gold bump structure and the solder. Further, a slower growth rate of the Cu-Ni-Sn self-formed compound is generated. The issues resulting from the rapid interaction between the gold bump structure and the solder and a fragile soldering point at the interface of the gold bump and the solder are resolved. Therefore, forming nickel as the lowest layer and gold as the outermost layer as taught by Yoda completely defeats the purpose of this invention. As stated in Ex parte Wisdom et al (POBA 1974) 184 USPQ 822, "A reference which performs a step of a process for a different purpose and does not recognize the problem solved in applicant's process does not render the process obvious" , let alone the fact that the order

of the layers taught by Yoda is incorrect and the thicknesses for both the copper and the nickel layers are undisclosed. Moreover, the formation of a nickel layer or Cu/Ni bi-layer on the gold bump, which mitigates the reaction between the gold bump and the copper-containing soldering materials due to formation of a self-formed compound at the gold-solder interface is an unexpected results and thereby is not obvious. Accordingly, the withdrawal of the rejections based upon Yoda is courteously solicited.

The Office Action rejected claim 7 under 35 U.S.C. § 103(a), as being unpatentable over Yoda and further in combination with Amagi (USP 6762506).

With regard to the obvious rejections of claims *by Yoda in view of Amagi,* Applicants respectfully submit that these claims patently define over the prior art for at least the same reasons as independent claim 5 discussed above.

In addition, the concentration of copper of Amagi is directed to the connecting terminals, rather than a part of a bump structure. Further, Amagi teaches a gold bump/ball 114 fixed with solder paste 214 having compositions of gold or an alloy containing Sn and pb (see column 3, ln. 35-41). The present invention, on the other hand, is directed to a gold bump with a nickel layer thereon and a copper-containing solder. Therefore, Yoda in view of Amagi still fails to render claim 5 of the invention unpatentable. Withdrawal of the rejections is respectfully requested.

The Office Action rejected claims 11, 13, 15, 18 and 20 under 35 U.S.C. § 103(a), as being unpatentable over Yoda and further in view of Takano (20020173108).

With regard to the obvious rejections of claims *in view of Takano,* Applicants respectfully submit that these claims patently define over the prior art for at least the same reasons as independent claims10 and 17 discussed above. Withdrawal of the rejections is respectfully requested.

Customer No. : 31561
Application No.: 10/707,825
Docket NO.:10786-US-PA

CONCLUSION

For at least the foregoing reasons, it is believed that the presently pending claims 1-22 are in proper condition for allowance. If the Examiner believes that a telephone conference would expedite the examination of the above-identified patent application, the Examiner is invited to call the undersigned.

Respectfully submitted,

Date : March 17. 2005

Belinda Lee

Belinda Lee
Registration No.: 46,863

Jianq Chyun Intellectual Property Office
7th Floor-1, No. 100
Roosevelt Road, Section 2
Taipei, 100
Taiwan
Tel: 011-886-2-2369-2800
Fax: 011-886-2-2369-7233
Email: belinda@jcipgroup.com.tw
Usa@jcipgroup.com.tw